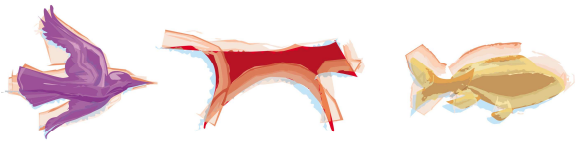


Invasive Animals Cooperative Research Centre

milestone report

IACRC project code:	**10.U.01**
IACRC project title:	**Woylie decline in Dryandra Woodland: Mesopredator Release?**
Project leader:	**Steve Lapidge**
IACRC project manager:	**Nicky Marlow**
Milestone number:	
Report submission date:	**November 2008**

Milestone

10.U.1.3.04 Fox abundance estimated in baited and unbaited sites (DMBs) i.e. (Tutanning)
10.U.1.3.06 Fox abundance estimated in baited and unbaited areas (Probaits) (i.e. Dryandra)
10.U.1.3.10 Fox and cat abundance estimated in baited and unbaited sites (Tutanning and Dryandra)

Abstract

The abundance of woylies (Bettongia penicillata) has declined in Dryandra Woodland. The reasons for this decline remain unclear as the fox baiting regime that initially resulted in enhanced woylie survival has been maintained. The effectiveness of the baiting regime is being investigated.

The ability of dried meat baits (DMBs) to kill foxes is being quantified. The activity of foxes and cats is being calculated in areas where dried meat baits and Probaits are being used. The methodology described in Allen *et al.* (1996) and Thomson *et al.* (2000) is being employed. Sandplots are monitored quarterly for three consecutive nights both before and after fox baiting event. Seventy five plots have been positioned in Tutanning Nature Reserve and 33 in each of the unbaited Highbury blocks.

The actual number of foxes present in these sites is being quantified by collecting hair samples at every second plot and analysing these using DNA analysis techniques to identify individual foxes. Fur samples may obtained by enticing animals to pass between three semi-vertical sticks, each with double sided tape adhered to it. This analysis is determining whether individual foxes are reaming in the site after each baiting event or whether foxes are being killed and new residents are immigrating in. The identity of foxes killing woylies is also being obtained using molecular techniques. This data will be used to quantify whether some individual foxes kill more than one woylie and if foxes are surviving consecutive baiting events.

The results of this work are of use to landholders and conservation estate managers because they indicate how effective the baiting regime is in removing foxes.

Project objectives

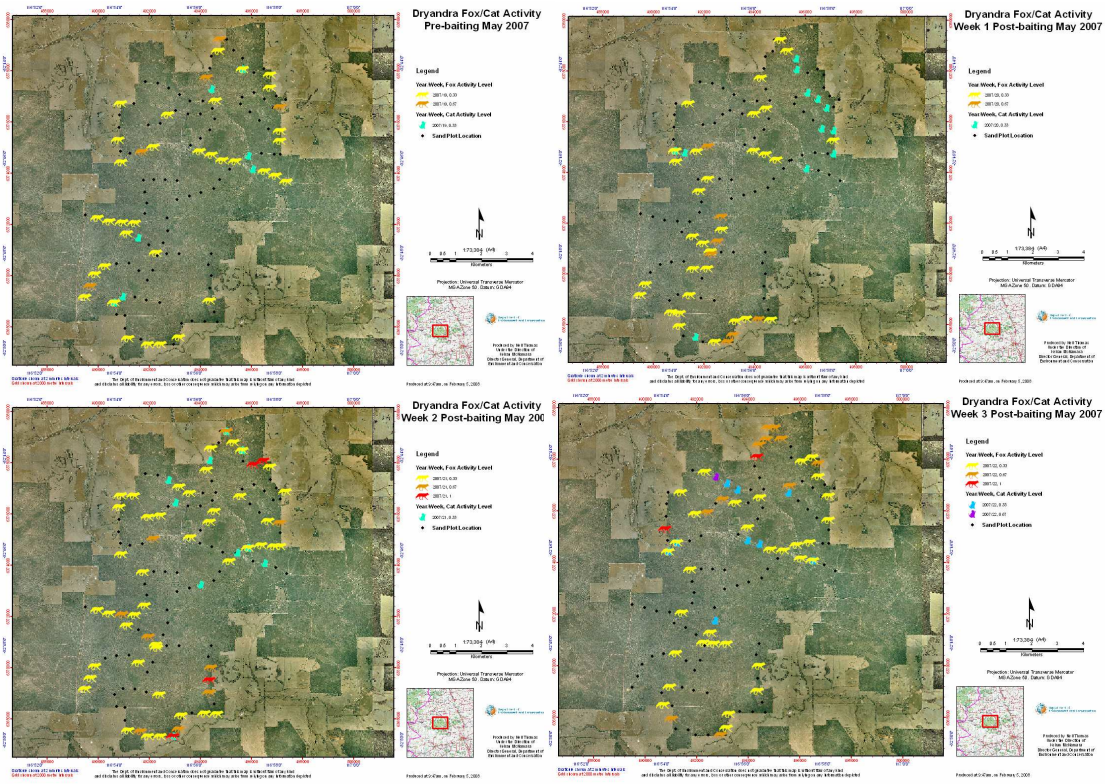
1) to determine if the current fox baiting regime is effective in reducing fox predation upon woylies
2) if the current fox baiting regime is inadequate, to improve it so that fox predation on woylies is minimised

3) to investigate if increased predation upon woylies by other introduced or native predators occurs when foxes are sufficiently controlled

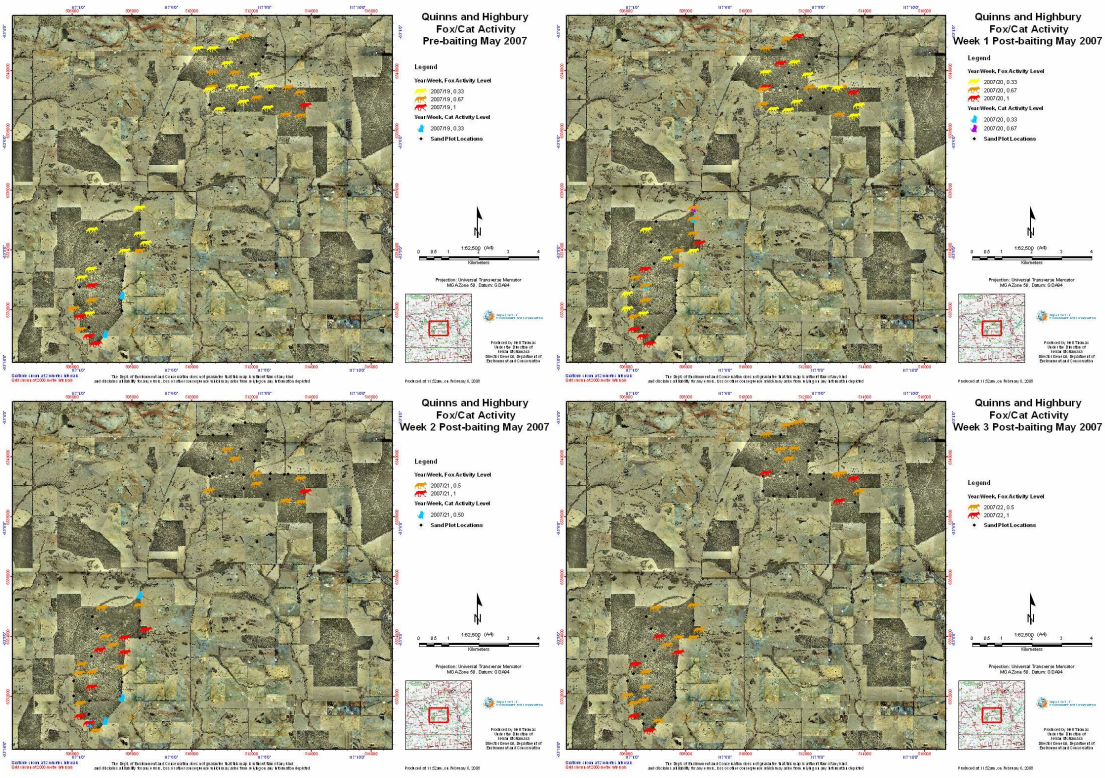
Fox and feral cat abundance will be monitored at sandplots in Dryandra Woodland, Tutanning Nature Reserve and two unbaited blocks of conservation estate near Highbury. Individual foxes and cats will be identified from DNA obtained from scats, saliva and fur. Sandplots will be monitored each quarter, following the regular fox baiting program. The change in feral cat abundance (mesopredator release, if any) that results from the control of foxes will be quantified by comparing relative densities of the two species in baited and unbaited areas. Foxes and feral cats, when detected, will be trapped and fitted with satellite collars (resources permitting). Their movements will be monitored continuously and their interactions (if any) and habitat partitioning identified. The predominate timing of reinvasion and the presence of bait wary foxes (if any) will be identified.

Success in achieving milestone

The activity of foxes and cats at sandplots in Dryandra, Tutanning and the unbaited sites of Quinns and Highbury has been monitored. These sandplots were monitored before and after fox baiting in May 2006, May 2007 (for a full rotation between baitings), October and November 2007, May 2008 and November 2008. The activity of foxes varied with timing after baiting and maybe influenced by the removal of foxes by baits. The identity of individual foxes therefore needs to be obtained to determine if resident foxes reside in the sites or new foxes move in repeatedly.



Hair samples have been collected from 34 active plots throughout the study areas. These is a difference in the recovery rate of hair samples between the baited and unbaited sites. In Dryandra there were 56 visits by foxes to sandplots but only two reveries of hair samples neither of which yielded any DNA. In Tutanning there were 33 visits to plots by foxes but again only two hair samples were collected and only one of which yielded DNA. In the unbaited sites there have been 30 hair samples collected from 8 different foxes. Several of these foxes repeatedly visited the plots. We are currently waiting for the results of further hair sample analyses before actual abundances of foxes can be calculated.



Milestone

Woylie survival monitoring

Abstract

The woylie (Bettongia penicillata) has declined in Dryandra Woodland. The reasons for it decline remain unclear as the fox baiting regime that initially resulted in enhanced woylie survival has been maintained. The survival of radio-collared woylies is being investigated at Dryandra Woodland and Tutanning Nature Reserve. Predation on woylies by foxes, feral cats, pythons and eagles is being quantified at both sites.

Woylies are trapped in Sheffield cage traps at Dryandra Woodland and Tutanning Nature Reserve. Their survival will be modelled as a function of several factors using the methodology described in Burnham and Anderson (2002). These factors include fox, cat, python and raptor predation.

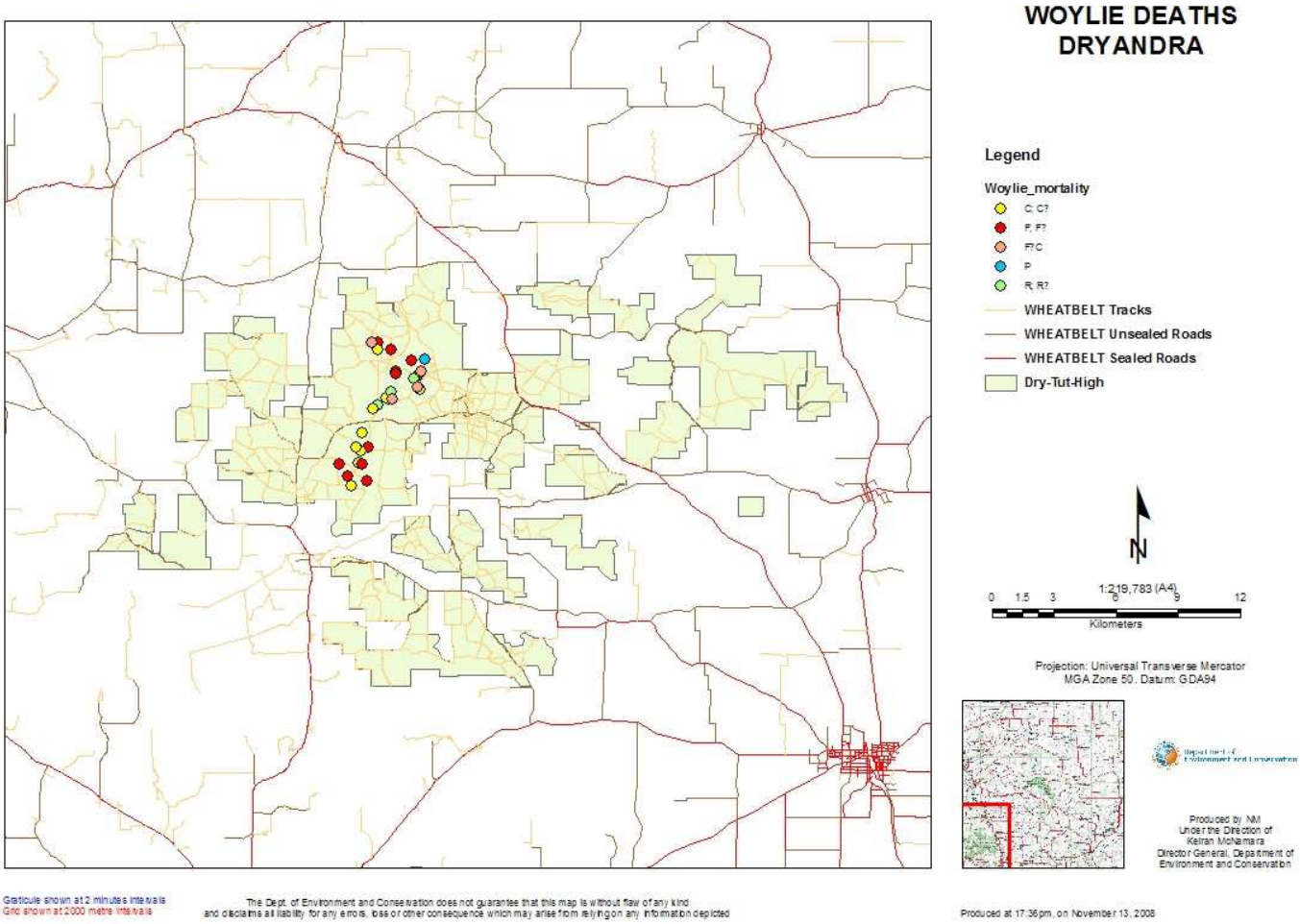
The predatory impact of foxes, feral cats, pythons and raptors is monitored through the use of mortality sensing radio-collars fitted to a sample of woylies at each site. These collars are monitored five days per week and the respective mortality agent (including the predator responsible) is identified when possible.

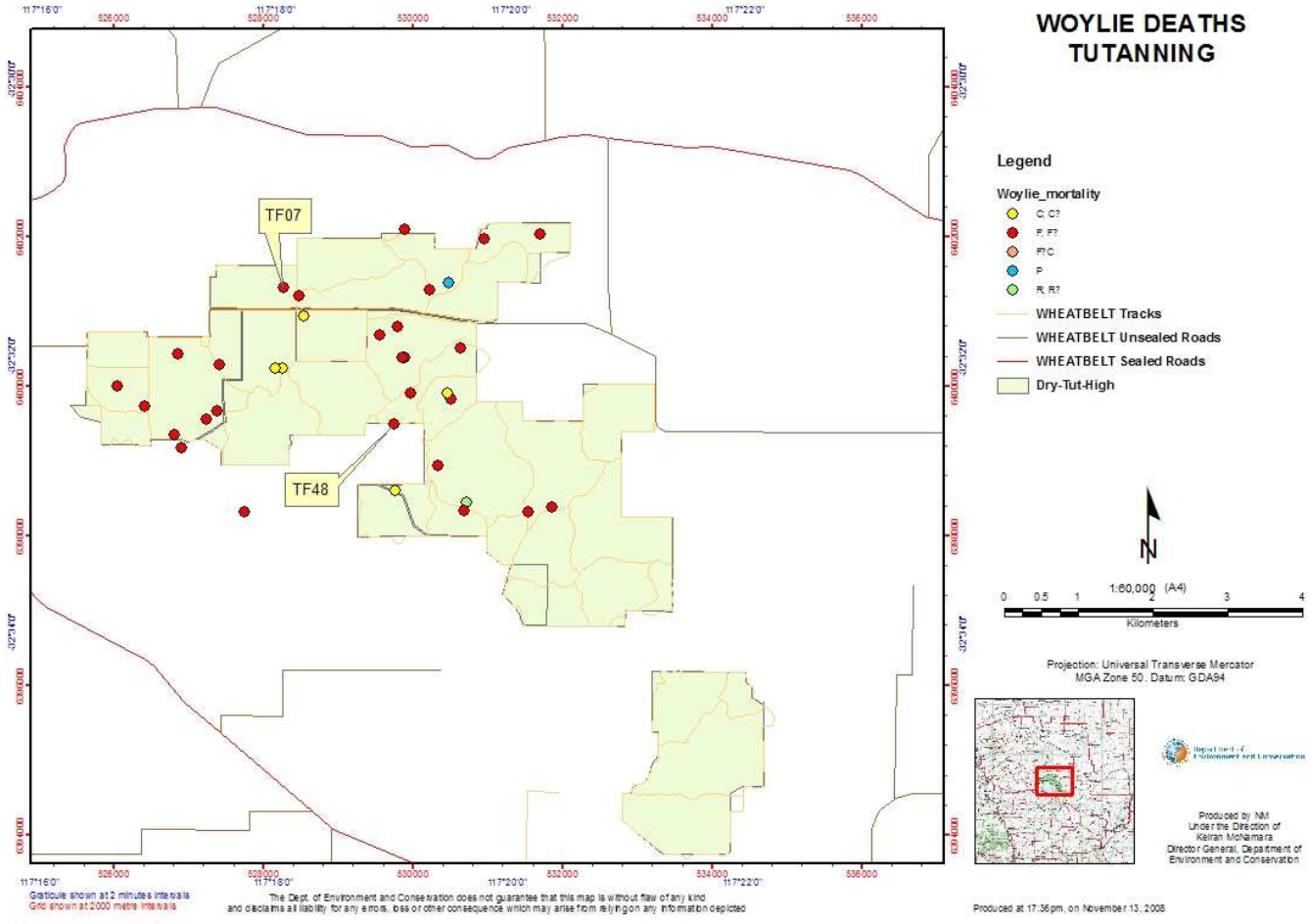
Success in achieving milestone

DRYANDRA				TUTANNING			
	♀	♂	**TOTAL**	♀	♂	**TOTAL**	**GRAND TOTAL**
CURRENTLY COLLARED	**11**	**9**	**20**	**10**	**6**	**16**	**36**
DEAD	**15**	**16**	**31**	**17**	**18**	**30**	**66**
MISSING	**0**	**4**	**4**	**2**	**2**	**4**	**8**
NOT COLLARED	**21**	**46**	**67**	**11**	**4**	**15**	**82**

TOTAL COLLARED	26	29	55	29	26	55	110
TOTAL HANDLED	47	75	122	40	30	70	192

	DRYANDRA		TUTANNING		TOTAL	
	N	%	N	%	N	%
FOX/ PROBABLE FOX	14	45	26	74	40	60
FOX/ CAT	7	23	3	9	10	15
CAT	7	23	3	9	10	15
RAPTOR/ PROBABLE RAPTOR	2	6	1	3	3	5
PYTHON	1	3	2	5	3	5





The results indicate that no mesopredator release of pythons or raptors is occurring but a release of feral cats may be occurring in Dryandra.

Modelling of the survival of woylies using the known fate model in Program Mark was undertaken Survival of 102 woylies was assessed by month with staggered entry. The results revealed that no sex, bait type or time factor influenced survival. Further analyses will be undertaken using climatic variables as covariates.

Model	AICc	DAICc	AICc weight	No of parameters	Model Likelihood
S(.)	330.2	0.0	0.51	1	1.00
S. + sex	331.9	1.7	0.21	2	0.41
S(g)	332.3	2.0	0.19	2	0.37
S(t)	333.6	3.4	0.09	29	0.18
S(g*t)	369.5	39.3	0.0	58	0.0

Milestone

10.U.1.3.07 Predator dietary analysis

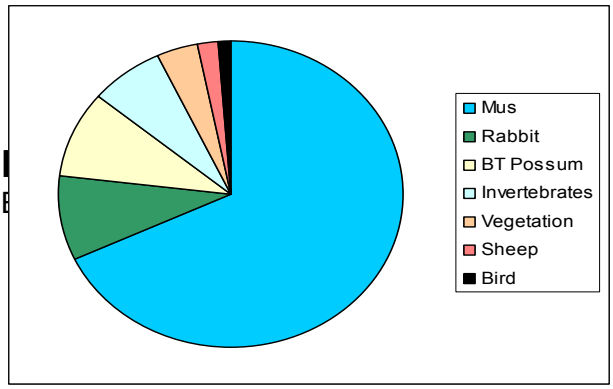
Abstract

The diet of foxes (and cats where possible) in baited and unbaited sites will be quantified by collecting scats from 20 km transects every three months. The contents of the scats will be quantified and differences between the sites determined. The diet of wedge-tailed

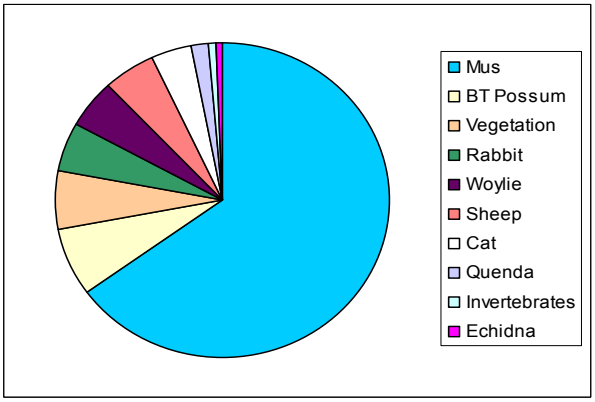
eagles will be assessed by mapping all nests in the baited and unbaited sites and collecting regurgitated pellets at each nest site every month. Again the contents will be quantified and differences between the sites identified. Other prey remains will also be collected from the nest site.

Success in achieving milestone

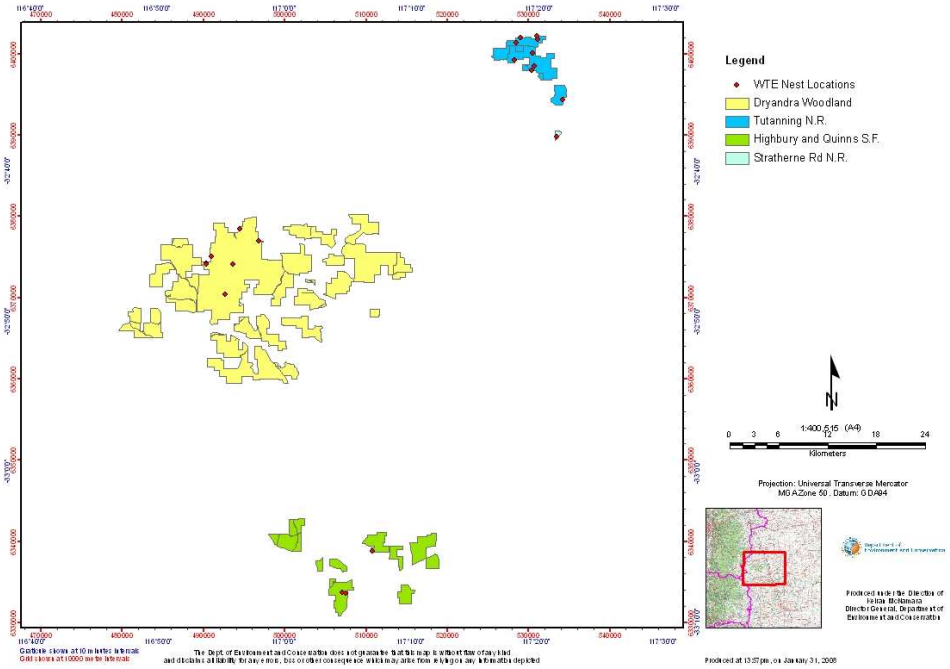
The scats of foxes (and ideally cats) are collected each season from predetermined transects and sandplots. Interestingly there are very few scats collected in Dryandra and Tutanning and this has hampered dietary analyses. Twenty seven fox scats have been analysed from Dryandra Woodland and 71 from Tutanning Nature Reserve. Only one scat has revealed the presence of woylie remains. Most of the mammalian content of the fox's diet is *Trichosurus vulpecula, Mus domesticus* or *Oryctolagus cuniculus*



The contents of 27 fox scats from Dryandra



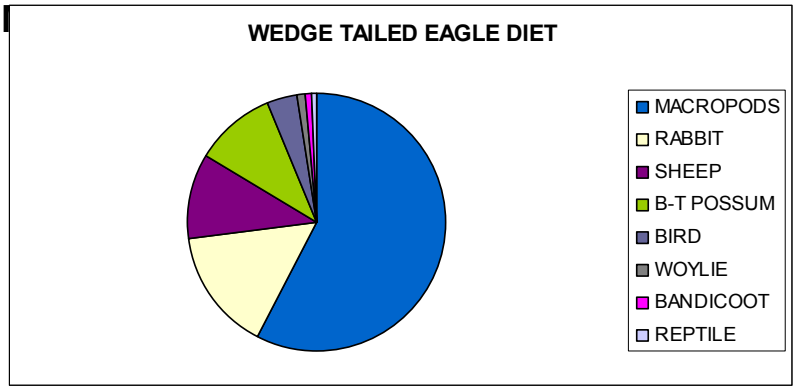
The contents of 71 fox scats from Tutanning
A further 294 scats have been collected and await analysis.



19 Wedge-tailed eagle nests have been identified.

Mammals were overwhelmingly the favoured prey of wedge-tailed eagles, constituting about 77% of total prey items by number and nearly 96% of the biomass of the 201 prey animals identified. Among the mammals taken, macropods (57.7% of total biomass, including tammar wallabies, 46.9%), rabbits *Oryctolagus cuniculus* (15.7%) and brush-tailed possums *Trichosurus vulpecula* (10.5%) were the most important prey species. At Tutanning in particular, tammar wallabies constituted more than half (53.7%) of the total diet biomass.

Birds were taken to a much lesser extent and contributing to a relatively minor proportion of eagle diet overall (14.5%, 3.6%). Important species of birds included ravens *Corvus coronoides* (6.0%, 1.4%) and pacific black ducks *Anas superciliosa* (2.5%, 1.2%). Reptiles were rarely taken as prey in the Narrogin region, contributing to 8.5% of total prey numbers but less than 1% of total diet biomass, with the bobtail skink *Tiliqua rugosa* (4%, 0.5%) being preferred.



Milestone
10.U.1.3.08 Fox and cat trapping

Abstract
Trapping for foxes will be undertaken and all individuals captured will be fitted with GPS collars that are programmed to disengage at a predetermined date. The predominate timing of reinvasion and the presence of bait wary foxes (if any) will be identified. When the tracks of foxes and cats are detected, attempts will be made to catch each individual using #1.5 size Victor soft-catch traps (Fleming *et al.* 1998). A variety of lures will be used to entice foxes and cats into the trap site including food, visual stimuli, aural lures (felid attracting phonics (FAPs)), or scent signals such as scats or urine. Traps will be checked every 12 hours (minimum) and will be positioned carefully to avoid capture of non-target species or detection by the public. Captured foxes and cats will be fitted with satellite telemetry collars (resources permitting) and data on their localities and status (alive or dead) will be recorded daily. The data obtained will be used to determine if they interact with each and/or if they partition their use of the habitat and thus influence their predatory impact upon native fauna. It is anticipated that up to 30 foxes and 10 feral cats will be trapped in each baited site. The persistence of radio-collared individuals and the repeated collection of DNA from specific individuals will reveal whether resident foxes (and cats) occur within the baited areas or whether all individuals are 'turned over' after each baiting event. This will reveal whether the current fox baiting regime is effective or whether modifications are required.

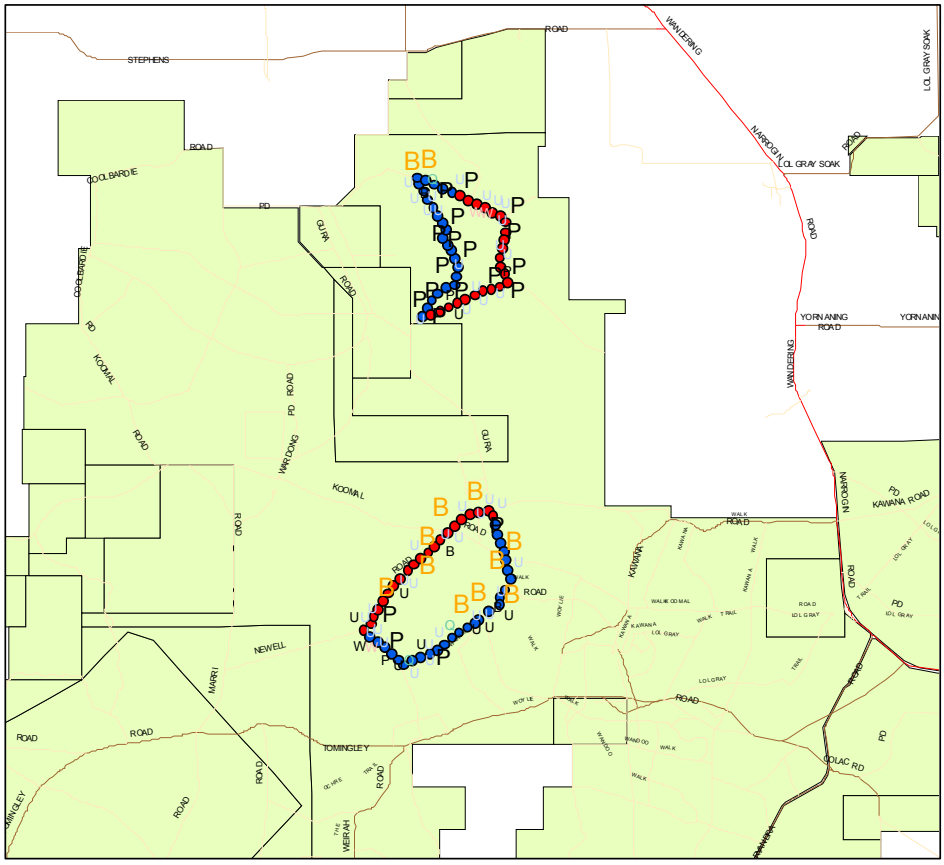
Success in achieving milestone
Two intensive trapping sessions for foxes have been undertaken:14-25/7/08 and13-19/10/08 Unfortunately the foxes in Dryandra are at very low density and are very wary. Out of 800 trap nights we have not had a single visit to a trap site by a fox. Another trapping trip is planned for January 2009.

Milestone
10.U.1.3.10 Bait effectiveness testing

Abstract
The fate of 1080 baits will be examined using a remote camera to record the species removing the baits at each of 50 sites within a replicated one square kilometre area. The agent responsible for removing the baits will be identified from photos taken with a remote camera. Three bait types will be tested: dried meat baits, Probaits and Eradicat.

The amount of 1080 lost from fox baits between baiting events will be quantified by placing baits with a known concentration of 1080 in bait cages and monitoring 1080 loss. Three cages will be used at Dryandra and each cage will contain 72 baits (24 of each bait type). Two baits of each type will be removed each week for 12 weeks and analysed for their 1080 content. Any loss of 1080 will be correlated with rainfall and the proportion of baits that become 'sublethal' (i.e. contain less than 1mg 1080) will be assessed. If leaching of 1080 occurs some areas may need to be rebaited if sufficient rain occurs. Also the amount of 1080 added to fox baits may need to be reassessed if many baits are becoming sublethal before they disintegrate.

Success in achieving milestone



SITE 1:
Baits lasted on average 25H 23 M (range 4-120 H)
Most baits were completely taken (96%) but some partial removal of bait occurred (Range 30-100%)

SITE 2
Baits lasted on average 74H 54M (range 8-168 H)
Only 72% of baits were removed intact. Partial bait removal ranged from 5-100%

Species	Site 1	Site 2	Total
Possum	7	17	24
Bird	10	2	12
Woylie	3	4	7
Quenda	2	1	3
Unknown	26	23	49
Total	48	47	95

The rapid uptake of baits by non-target species resulted in too few baits being available to foxes to produce effective fox control. The baiting regime is therefore going to be intensified. The 1080 loading of baits was increased to 4.5mg per bait (from 3mg per bait) (21/08/08 to December 2009) and the intensity of baiting in northern Dryandra is being increased to 50 baits per square kilometre (21/11/08 to December 2009).

Recommendations

Although the milestones for this project will be met within the proposed time frame of the project, there are now many new avenues of research that need to be addressed as a consequence of the results obtained. With the assistance of CfoC funding, it has been suggested that research at this demonstration site should be continued beyond its current time frame. This will enable the cat bait to be fully tested and the optimum intensity and frequency of delivery of that bait to be quantified. The impact of effective fox and cat control on the recovery of the woylie population could also be monitored.

Appendices

Communications:

- Seminars/ presentations
  - Society for Conservation Biology conference, Tennessee, August 2008
  - Highbury public meeting,
  - Cuballing public meeting,
  - Barna Mia public meeting,
  - Dryandra landholders public meeting (2)
  - Fauna program review
  - Wheat belt managers review
- Radio interview
  - ABC Albany
- Newspaper
  - Narrogin observer

Anticipated publications

- *de Tores and Marlow,* An overview of 1080 baiting programs for control of the introduced red fox, *Vulpes vulpes*, in Western Australia, an investigation of the potential for mesopredator release, and recommendations for future management and research, *Biol Conservation*
- *Marlow, Berry, Matt Williams, de Tores, Wayne, Clarke, Andy Williams, Thomas, McMahon and Lawson,* Modeling predation characteristics to identify predators - validation through molecular techniques, *Biol Conservation*
- *de Tores, Marlow, Thomas, Hayward,* Localised and landscape scale introduced predator control in Western Australia – can it deliver the same results as predator exclusion fencing?, *Book Chapter in Verlag Springer publication from the Society for Conservation Biology Conference, Tennessee, August 2008*
- *Marlow, Berry, Matt Williams, de Tores, Wayne and Clarke,* Modelling predation characteristics to ID predators and validation through molecular techniques, *Biol Conservation*
- *Marlow, Macmahon, Thomas, A. Williams, Lawson ,* Modelling survival of woylies (Bettongia penicillata) in Dryandra Woodland and Tutanning Nature Reserve, *Biol Conservation*
- *Marlow, Thomas, Macmahon, A. Williams, Lawson ,* Baiting effectiveness in two Wheatbelt reserves, *J Appl Ecol*
- *Marlow, Macmahon, A. Williams, Lawson, Thomas,* Modelling the diet of foxes in relation to woylie survival in Dryandra Woodland and Tutanning Nature Reserve, *Wildlife Research*
- *Marlow, Macmahon, Brazell, Lawson,* Fox bait longevity in Dryandra Woodland and Tutanning Nature Reserve, *Wildlife Research*
- *Marlow, Thomas, Macmahon, A. Williams, Lawson ,* Population dynamics and viability of woylies (Bettongia penicillata) in Dryandra Woodland and Tutanning Nature Reserve, *J Appl Ecol*
- *Marlow, A. Williams, Macmahon, Cherriman,* Wedge tailed eagle diet in Dryandra Woodland and Tutanning Nature Reserve, *Wildlife Research*
- *Marlow, Thomas, Macmahon, A. Williams, Lawson,* What woylie decline'?, *Landscope*
- *A. Williams, Marlow, Cherriman,* Wedge tailed eagles in Dryandra and Tutanning, *Landscope*
- *Thomas, Marlow, Macmahon,* Fox bait uptake at Dryandra and Tutanning, *Landscope*